UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

Memorandum

DATE:	August 28, 2001
SUBJECT:	Lowbush and Highbush Blueberries Benefits Assessment for Azinphos-methyl and Phosmet
FROM:	Neil Anderson, Agronomist Herbicide and Insecticide Branch Nikhil Mallampalli, Ph.D, Entomologist Herbicide and Insecticide Branch Timothy Kiely, Economist Economic Analysis Branch Biological and Economic Analysis Division (7503C)
THROUGH:	David Brassard, Senior Entomologist Jonathan Becker, Acting Chief Herbicide and Insecticide Branch Arthur Grube, Senior Economist David Widawsky, Acting Chief Economic Analysis Branch Biological and Economic Analysis Division (7503C)
TO:	Diane Isbell, Chemical Review Manager Veronique LaCapra, Chemical Review Manager Margaret Rice, Chief Reregistration Branch 2 Special Review and Reregistration Division (7508C)
CC:	Denise Keehner, Director Biological and Economic Analysis Division (7503C)

Summary of Analysis

Azinphos-methyl and phosmet are critical pest management inputs for U.S. blueberry growers. Extending the restricted entry interval (REI) for either of these chemicals on blueberries could result in significant impacts on blueberry growers. There are two primary types of blueberries grown in the U.S., lowbush and highbush. The production of lowbush blueberries occurs almost entirely in Maine, while highbush blueberry production occurs primarily in three regions: the Pacific North (Oregon and Washington), the North Central (Michigan and Indiana), and the East (New York, New Jersey, Florida,

Georgia, North Carolina, Alabama, and Arkansas). The following analysis provides an overview of U.S. blueberry production, the role of phosmet and azinphos-methyl in blueberry production, and estimates of the impacts of extending the REIs of azinphos-methyl and phosmet on lowbush and highbush blueberries.

Lowbush Blueberries

For lowbush blueberries, azinphos-methyl and phosmet are critical for the control of blueberry maggot, which is the primary pest on lowbush blueberries. On average, azinphos-methyl is applied to 36% of U.S. lowbush blueberry acreage, and phosmet is applied to 12% of U.S. lowbush blueberry acreage. Application of both chemicals occurs just prior to or during harvest for the control of the blueberry maggot. Growers conduct multiple harvests during the period that the blueberry maggot is present, and any REI above 7 days for phosmet and 10 days for azinphos-methyl will not allow growers to achieve adequate control of blueberry maggot and carry out critical harvest activities. At an REI of 7 days for phosmet for hand harvesting the impacts on lowbush blueberry growers will be minor. Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for this chemical.

At an REI of less than or equal to 10 days for azinphos-methyl, the impacts on lowbush blueberry growers will be minor. However, at an REI longer than 10 days, growers will likely choose to no longer use azinphos-methyl, and could face higher costs from having to use more expensive chemicals controls. Grower and national net revenues are estimated to decline at least 1% from current net revenues as a result of having to use more expensive insecticides for the control of blueberry maggot (see Table 1).

Table 1. Lowbush Blueberry Grower and National Level Impacts of Extending Azinphos-methyl REI on Lowbush Blueberries [1]

Scenario	Grower Level Impact	National Level Impact
REIs: Azinphos-methyl: >10days (Azinphos-methyl not used)	Current Net Revenues: $460/A New Net Revenues: $454/A **Net Loss:** $6/A	Current Net Revenues: $13.8 million New Net Revenues: $13.7 million **Net Loss:** $0.1 million

1. See General Assumptions section for a discussion of the assumptions and calculations.

Highbush Blueberries

Azinphos-methyl and phosmet are critical on highbush blueberries for the control of Japanese beetle, blueberry maggot, and fruitworms. Japanese beetle is a serious pest in the North Central and East Regions. Blueberry maggot is considered the most serious pest in the East, and is an important pest in other production regions as well. Fruitworms are a serious pest in all three regions. On average, azinphos-methyl is applied to 48% of U.S. highbush blueberry acreage, with more than 70% of its usage occurring in the North Central Region. Phosmet is applied to 39% of U.S. highbush blueberry acreage, with more than 60% of its usage in the North Central Region. Azinphos-methyl is critical during the early part of season, while phosmet is used primarily prior to or during the harvest period due to its shorter REI than azinphos-methyl. At any REI above 3 days for phosmet and 7 days for azinphos-methyl, growers will not be able to achieve adequate control of the critical pests and still complete critical in-season and harvest activities. Growers will likely choose to no longer use phosmet and azinphos-methyl, and could face losses in the quality of the fruit produced and higher costs from having to use less effective and more expensive chemicals controls.

BEAD developed three (3) hypothetical mitigation scenarios with the aim at assessing the individual benefits of the use of azinphos-methyl and phosmet and the impact of extending the REIs for these two chemicals on highbush blueberries. These scenarios serve as the basis for this assessment:

- Scenario 1 - Azinphos-methyl REI less than or equal to 7 days, and phosmet REI greater than 3 days.

Phosmet would no longer be used by growers.

- Scenario 2 - Azinphos-methyl REI greater than 7 days, and phosmet REI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.
- Scenario 3 - Azinphos-methyl REI greater than 7 days, and phosmet REI greater than 3 days. Both azinphos-methyl and phosmet would no longer be used by growers.

The impacts associated with the scenarios assessed are presented as changes in net revenues at the grower level and regional level. The quantitative impacts presented are the result of substituting less effective and more expensive alternate pest control methods for applications of either phosmet or azinphos-methyl or for both active ingredients. Estimated impacts include losses in the quality of the fruit harvested and increases in the cost of production. Impacts are estimated to occur for several reasons: 1) reduced pest control efficacy or difficulty in timing pest control applications before pest damage occurs; 2) interruptions in critical in-season and hand harvesting activities; and 3) applications of additional insecticides to control expected pest outbreaks.

Table 2 provides a summary of the grower and regional level impacts expected in the North Central and East Regions from the three scenarios (no impacts are expected to result from extending the REIs of azinphos-methyl and phosmet in the Pacific North Region).

North Central Region

- Without phosmet (scenario 1), growers could face quality losses of up to 15% and increases in the cost of pest control. Net revenues are estimated to decline as much as 25% at the grower level and 13% at the regional level.
- Without azinphos-methyl (scenario 2), growers could face quality losses of up to 2% and increases in the cost of pest control. Net revenues are estimated to decline as much as 4% at the grower level and 3% at the regional level.
- Without phosmet and azinphos-methyl (scenario 3), growers could face quality losses of up to 15% and increases in the cost of pest control. Net revenues are estimated to decline as much as 26% at the grower level and 19% at the regional level.

East Region

- Without phosmet (scenario 1), growers could face quality losses of up to 15% and increases in the cost of pest control. Net revenues are estimated to decline as much as 15% at the grower level and 3% at the regional level.
- Without azinphos-methyl (scenario 2), growers could face quality losses of up to 2% and increases in the cost of pest control. Net revenues are estimated to decline as much as 3% at the grower level and 1% at the regional level.
- Without phosmet and azinphos-methyl (scenario 3), growers could face quality losses of up to 15% and increases in the cost of pest control. Net revenues are estimated to decline as much as 16% at the grower level and 3% at the regional level.

Table 2. Highbush Blueberry Grower and Regional Level Impacts of Extending Phosmet and Azinphos-methyl REIs on Highbush Blueberries [1]

Scenario	Region	Grower Level Impact	Region Level Impact
1 REIs: Azinphos-methyl: =/<7 days Phosmet: >3 days 0 (Phosmet not used)	North Central	Current Net Revenues: $1,120/A New Net Revenues: $845/A to $1,004/A **Net Loss:** $116/A to $275/A	Current Net Revenues: $19.4 million New Net Revenues: $16.8 to $18.3 million **Net Loss:** $1.1 to $2.6 million
	East	Current Net Revenues: $1,505/A New Net Revenues: $1,275/A to $1,372/A **Net Loss:** $138/A to $230/A	Current Net Revenues: $26.6 million New Net Revenues: $25.8 to $26.1 million **Net Loss:** $0.5 to $0.8 million
2 REIs: Azinphos-methyl: >7 days Phosmet: =/<3 days (Azinphos-methyl not used)	North Central	Current Net Revenues: $1,120/A New Net Revenues: $1,074/A to $1,094/A **Net Loss:** $26/A to $46/A	Current Net Revenues: $19.4 million New Net Revenues: $18.8 to $19 million **Net Loss:** $0.4 to $0.6 million
	East	Current Net Revenues: $1,505/A New Net Revenues: $1,457/A to $1,476/A **Net Loss:** $29/A to $48/A	Current Net Revenues: $26.6 million New Net Revenues: $26.4 to $26.5 million **Net Loss:** $0.1 to $0.2 million
3 REIs: Azinphos-methyl: >7 days Phosmet: >3 days (Azinphos-methyl and Phosmet not used)	North Central	Current Net Revenues: $1,120/A New Net Revenues: $829/A to $912/A **Net Loss:** $208/A to $291/A	Current Net Revenues: $19.4 million New Net Revenues: $15.7 to $16.8 million **Net Loss:** $2.6 to $3.7 million
	East	Current Net Revenues: $1,505/A New Net Revenues: $1,267/A to $1,364/A **Net Loss:** $141/A to $238/A	Current Net Revenues: $26.6 million New Net Revenues: $25.7 to $26.1 million **Net Loss:** $0.5 to $0.9 million

1. See General Assumptions section for a discussion of the assumptions and calculations.

Structure of The Assessment

The structure of the biologic and economic assessment of the use of azinphos-methyl and phosmet on blueberries will follow the outline provided below. The main elements of the assessment will be split into a biological assessment of the use of azinphos-methyl and phosmet on blueberries grown throughout the United States and an economic assessment of the impacts on net revenues caused by various modifications on existing use patterns. By blueberry type and production region, the assessment will describe the production and cultural practices of growing both lowbush and highbush blueberries; the use of azinphos-methyl and phosmet including the percent of crop treated, average application rates, the number of applications, target pests, and the timing of applications; potential pest control alternatives; and, the quantitative and qualitative impact of the scenarios. Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for this chemical.

Scope and Limitations of the Assessment

The scope of this analysis will attempt to identify potential grower-level, regional-level and national impacts associated with various regulatory constraints placed on the use of azinphos-methyl and phosmet in blueberries. The restrictions that serve as the basis for our impact estimates in this report reflect mitigating post application risks to workers entering treated areas identified by the Health Effects Division of the Office of Pesticide Programs. This analysis does not attempt to address impacts associated with mitigation efforts targeted at workers engaged in mixing, loading or applying azinphos-methyl or phosmet to blueberries or potential mitigation for various environmental risks (i.e., risk mitigation for risks to terrestrial plants and organisms or water contamination).

There are limitations to our assessment. The impacts estimated by this analysis only represent potential short-term--1 to 2 years--impacts on the blueberry production system. Assumptions about yield and quality losses associated with the various scenarios are based on the best professional judgement of BEAD analysts because estimates were not available from other sources. The basis for these assumptions is based on a knowledge base developed from reviewing available USDA crop profiles, state crop production guides, discussions with university extension and research entomologists knowledgeable in blueberry production, and other sources listed.

Based on available information, BEAD has attempted to quantify impacts associated with extending post-application reentry intervals for azinphos-methyl and phosmet on lowbush and highbush blueberries. For lowbush blueberries BEAD was able to qualitatively estimate the impacts of extending the REIs for phosmet to 7 days, and quantitatively estimate the impacts of extending the REIs for azinphos-methyl to longer than 10 days.

For highbush blueberries BEAD quantitatively assessed the impacts of extending the REIs for azinphos-methyl and phosmet. To complete this task, we developed three hypothetical mitigation scenarios with the aim at assessing the individual benefits of the use of azinphos-methyl and phosmet on highbush blueberries:

- Scenario 1 - Azinphos-methyl REI =/< 7 days, and Phosmet REI > 3 days. Phosmet would no longer be used by growers.
- Scenario 2 - Azinphos-methyl REI > 7 days, and Phosmet REI =/< 3 days. Azinphos-methyl would no longer be used by growers.
- Scenario 3 - Azinphos-methyl REI > 7 days, and Phosmet REI >3 days. Both azinphos-methyl and phosmet would no longer be used by growers.

Blueberry production, both lowbush and highbush, is a very complex system that can be impacted by any number of things. BEAD’s ability to quantitatively capture the wide array of events that could unfold given each hypothetical scenario listed above is very limited. Those elements that we have been unable to quantify will be discussed in a qualitative fashion in an attempt to inform risk managers that additional--but not less important--unquantifiable events could occur if additional regulatory restrictions are placed on azinphos-methyl or phosmet.

Background of U.S. Blueberry Production

Blueberries are one of the two crops that are the only two commercially cultivated fruit crops native to North America alone; cranberries are the second. Although wild blueberries were used extensively by indigenous people and early European settlers, they are among the most recently domesticated fruit crops. North America is the world's leading blueberry producer, accounting for nearly 90% of world production at the present time. Cultivated blueberries are grown in more than 30 states as well as in British Columbia. Nearly half of the cultivated blueberries grown are sold as fresh blueberries. Fresh blueberries are available for nearly eight months of the year from producers across the Untied States and Canada. Three major cultivated types of blueberries exist: the lowbush blueberries of Maine and eastern Canada, the highbush blueberries native to the eastern U.S., and the rabbiteye blueberries of the deep South. Hybrids between these groups are also grown commercially.

The lowbush blueberry (*Vaccinium angustifolium*) is harvested from managed wild stands in the eastern provinces of Canada and the northeastern U.S. Maine is the largest single producer of lowbush blueberries. The highbush blueberry (*V. crymbosum*) is the major cultivated species in North America. It occurs in native stands from southern Nova Scotia west to southern Wisconsin and south along the Atlantic coast and to eastern Texas. The rabbiteye blueberry (*V. ashei*) is grown in the southeastern U.S. with production in Georgia, North Carolina and several other states. There are over 70,000 acres of blueberries grown in the U.S. (includes all 3 types).

Since blueberries are one of the only commercially grown endemic fruit crops, there are no major imported insect or disease pests of the crop. The blueberry flower is also not easily pollinated by the honey bee, which evolved in Europe and Asia, so native wild bees are the most effective pollinators where they are available in sufficient numbers.

Lowbush Blueberries (Wild)

Lowbush Blueberry Production and Cultural Practices

Maine produces 98% of the wild blueberries (lowbush) in the U.S. harvested from 30,000 acres. There are 30,000 additional acres of non-bearing lowbush blueberries each year (see Table 3). Nearly all of the harvested crop is processed (99%). Wild blueberries are grown on fields that have been developed from native plants that occur naturally in the understory of the forest. Lowbush blueberries are not planted, growers manage native stands for harvest. There are actually two species of lowbush blueberries in production in Maine. *V. angustifolium* is the most abundant and is known as the low sweet blueberry, with plants varying in height from four to 15 inches tall. The other lowbush species, *V. myrtilloides*, also known as the sour top blueberry, tends to be more prevalent in mountains or hilly areas and grows from six to 24 inches tall. Because of pruning practices employed (burning and mowing) every other year, only half of the acres are available for harvest each year (USDA Crop Profile for Blueberries (Wild) in Maine, Aug 1999). In the growing season immediately following the pruning, the vegetative and formative growth takes place. Flower buds are formed during May with bloom lasting from 2 to 4 weeks. Blueberries require cross pollination for a successful fruit set. After pollination and fruit set, the blueberries develop and ripen for harvest in late July and August.

Lowbush blueberries are harvested generally beginning at the end of July and can extend through Labor Day. Harvesting is completed in one picking operation with approximately 80% of the acreage done by hand raking the berries from the plant, the remaining 20% of the acreage is harvested by mechanical means (D. Yarborough, personal communication). Hand raking is done with the use of a metal rake with closely-spaced tines that is pushed with a twisting motion through the foliage to pluck the ripe berries from the vine without crushing them. The rakes are designed with a catch basin for holding the berries for easy pouring into plastic totes.

Table 3. Maine Wild (Lowbush Blueberry) Production and the Value of Production by End Use[1, 2]

Region	Harvested Acreage (Acres)	Production (1000 Pounds)			Value of Production ($1000)		
		Total	Fresh	Processed	Total	Fresh	Processed
Maine	30,000	64,423	211	64,212	$31,397	$214	$31,183

1. Source: USDA/NASS Noncitrus Fruits and Nuts 2000 Preliminary Summary.
2. According to USDA's Maine crop profile, Maine produces 98% of U.S. lowbush blueberries.

Azinphos-methyl and Phosmet Usage and Target Pests

Phosmet and Azinphos-methyl Usage

The estimated average annual usage of azinphos-methyl and phosmet on lowbush blueberries is listed in Table 4. In 1997, phosmet was applied to an estimated 12% of the of the lowbush blueberry acreage in Maine and azinphos-methyl to an estimated 36% (NCFAP, 2000). Approximately 90 percent of all applications of azinphos-methyl and phosmet are applied aerially, with 2/3 applied with fixed-wing aircraft and 1/3 by helicopter (Yarborough, personal communication).

Recommended use rates for azinphos-methyl are 0.25 lb. active ingredient/acre to a maximum of 0.75 lb. a.i./A. A total of three applications may be made per crop season regardless of rate or formulation used with at least a 10-day interval between applications. The minimum interval between the last application and harvest (PHI) is 7 days.

Recommended use rates for phosmet are 0.93 lb a.i./A with what appears to be a limit of 2 applications allowed per year according to the label (accepted 6/28/200, reg. #10163-169). However, information from knowledgeable experts indicates that more than 2 applications occur. The minimum interval between the last application and harvest (PHI) is 3 days.

Table 4. Usage of Azinphos-methyl and Phosmet on Main Lowbush Blueberries [1]

Active Ingredient	Percent of Crop Treated	Base Acres Treated (1000 acres) [2]	Total Pounds Applied (1000 lbs)
Azinphos-methyl	36%	11	2
Phosmet	12%	4	4

1. Source: National Center for Food and Agricultural Policy database (1997).
2. Base acres treated calculated using percent of crop treated estimates and harvested acreage from Table 3.

Target Pests

The primary target pest in lowbush blueberries that phosmet and azinphos-methyl are used against is the blueberry maggot, also known as the blueberry fruit fly (*Rhagoletis mendax* Curran). Phosmet also has use targeted at blueberry flea beetle, blueberry spanworm and blueberry sawfly. Phosmet and azinphos-methyl use targeted at the blueberry maggot only occurs during the year that berries are harvested from the plant, in other words, every other year. Dr. Yarborough estimated that current use of these two compounds to control this pest is evenly divided between them. Historically, azinphos-methyl had a greater market share for blueberry maggot control when compared to phosmet, however, in recent years use of phosmet has increased while azinphos-methyl use has decreased because of grower concerns over the toxicity and odor associated with it (Yarborough, personal communication).

The blueberry maggot is the most economically damaging pest for lowbush blueberries. The blueberry maggot feeds inside ripening fruit and may remain there for some time after harvest. Infested berries can not be separated from sound berries during harvest and packing and maggots may emerge from the berries at the point of sale. Because of the inability to identify infested fruit, and the potential for consumer alarm at the sight of this pest in their purchased product, there is a zero tolerance for this pest. Processors actively monitor loads for infected berries and will reject an entire load if a single maggot is discovered.

Blueberry maggot flies emerge after overwintering in the soil in late June or early July and continue to emerge until early August. After emerging, the adult flies spend 1 to 2 weeks resting and feeding on dew, insect honeydew and secretions on foliage. During this time period the adult females mate and seek ripening berries in which to lay their eggs. Each female fly may lay up to 100 eggs in a period of 15 to 25 days. One egg per berry is oviposited just under the skin where the egg will hatch in approximately one week and the maggot will feed for about 3 weeks inside ripening and harvested fruit.

Growers have utilized an IPM program for maggot control for 20 years. Monitoring for adult flies with baited yellow sticky traps begins at the end of June in order to predict when a chemical application might be necessary. On average, 1 to 2 sprays are timed to control the blueberry maggot based on trap catches. Aerial spraying (fixed wing and rotary) is the primary application method for insecticides because of field terrain; however, ground applications are also used to a limited extent (<10% of acreage).

Phosmet use targeted at the blueberry flea beetle, blueberry spanworm, and blueberry sawfly, while infrequent, generally would occur earlier in the production cycle from April through late June depending on which of the three pests are being targeted and infestation levels.

Potential Pest Control Alternatives

Chemical control alternatives to phosmet and azinphos-methyl may include malathion, carbaryl or the recently registered esfenvalerate and tebufenozide. Malathion is not used extensively because phosmet and azinphos-methyl provide superior efficacy and a longer period of control for blueberry maggot. Carbaryl use on lowbush blueberries was estimated to be 100% in 1992 (NCFAP); however, by 1997 use had dropped all the way to 0 (NCFAP and USDA Crop Profile for Blueberries (Wild) in Maine, Aug 1999). This dramatic shift occurred because the PHI for carbaryl was extended from 0 days to 7 days, effectively removing it from the market. Esfenvalerate was recently registered for use on blueberries in Maine, however, it reportedly does not provide consistent control of the blueberry maggot and it has a 14 day PHI which will severely limit its use during the harvest period. Tebufenozide was recently registered for control of the fruitworms and leafroller species and will be used at bloom time because it is safe for pollinators. Additional applications are allowed when pest pressure warrants. Tebufenozide has a 4 hour REI and a 14-day PHI so use close to, or during, harvest is not likely.

Restricted Entry and Pre-harvest Intervals

The current label REI for azinphos-methyl is 4 days (5 days in areas receiving less than 25 inches of rainfall per year) and the PHI is 7 days. Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for this chemical.

For phosmet, the current label REI is 1 day and the PHI is 3 days. The phosmet registrant has proposed a 7 day restricted entry interval for all activities. Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for this chemical.

Impact of Potential REI Extensions for Azinphos-methyl and Phosmet on Lowbush Blueberry Production

Field worker activities that occur during the lowbush blueberry growing season are limited to primarily field scouting and hand harvest. Hand pruning and fruit thinning are not activities that are practiced in lowbush blueberry production. Applications of phosmet and azinphos-methyl primarily occur just prior to or during the harvest period of late July through Labor Day for blueberry maggot control, resulting in potential worker exposure.

The current pre-harvest interval (PHI) for phosmet on blueberries is 3 days. Extending the REI from the existing 24 hours to 7 days would not likely cause an undue burden to growers, even though that would, in effect, create a new PHI of 7 days for the hand harvested acreage. Dr. Dave Yarborough, extension blueberry specialist with the University of Maine, indicated that growers could adjust their hand harvest activities accordingly without negatively impacting their harvest if a 7 day

REI were instituted.

Extending the REI for azinphos-methyl to a similar level, 7 to 10 days, would not result in grower-level impacts. However, extending the REI to levels greater than 10 days could begin to impact the use of azinphos-methyl and result in grower-level impacts because growers may shift usage to more expensive alternate pest control methods.

Grower and National Level Impacts

Based on available information, BEAD has attempted to quantify the impacts associated with extending post-application reentry intervals for azinphos-methyl on lowbush blueberries to longer than 10 days. The following section summarizes the estimated impacts of extending the REIs of azinphos-methyl on grower level net revenue. For this assessment, net revenue is considered operating net revenue. That is, the assessment only considers the impacts of extending the REIs of phosmet and azinphos-methyl on the blueberry growers ability to meet operating expenses. Net revenue is defined as revenue minus cost, where revenue equals the quantity produced multiplied by the price received by growers, and cost equals the farm level operating (or variable) cost of production.

Tables 5 and 6 lists the impacts at the grower level and national level, respectively, of extending the REI of azinphos-methyl to longer than 10 days on lowbush blueberries. In Table 5, the first row lists the current yield, prices, revenues, costs, and net revenues for lowbush blueberries, and the second row lists the estimate of impacts of extending the REI of azinphos-methyl longer than 10 days. In Table 6, current national net revenues (current total) and the national net revenues as a result of extending the REI of azinphos-methyl longer than 10 days (new total) are listed. The net loss estimate (bolded) in the last column of the second row in Table 5 and the last column of Table 6 is the difference between current net revenues and the estimated net revenues expected as a result of extending the REI of azinphos-methyl longer than 10 days. (Please see General Assumptions section for a more complete discussion of the impacts.)

- At the grower level (see Table 1), the estimated impact of not having azinphos-methyl available for use on lowbush blueberries is a reduction in grower net revenues of $6 (to $454 per acre), which is a decline of 1% from current grower net revenues ($460 per acre).
- At the national level (see Table 1), the estimated impact of not having azinphos-methyl available for use on lowbush blueberries is a reduction net revenues of $0.1 million , which is a decline of 1% from current national net revenues.

Table 5. Summary of Lowbush Blueberry Grower Level Impacts [1]

Scenario	Yield	Quality Impact (Price)	Revenues	Operating Costs	Net Revenues
Current Situation	Current total: 2,150 lbs/A	Prices: $0.48/lb	Current: $1,040/A	Current: $580/A	Current: $460/A
Scenario: REIs: Azinphos-methyl: > 10 days	Yield loss: None	No Quality Change	No Change	New: $586/A	New: $454/A **Net Loss:** $6/A

1. See General Assumptions section for a discussion of the assumptions and calculations.

Table 6. Summary of Lowbush Blueberry National Level Impacts[1]

Scenario	Region	Net Revenues
Scenario: REIs: Azinphos-methyl: >10 days	National	Current total: $13.8 million New Total: $13.7 million **Net Loss:** $0.1 million

1. See General Assumptions section for a discussion of the assumptions and calculations.

Highbush Blueberries (Including Rabbiteye)

Highbush Blueberry Production and Cultural Practices

Highbush Blueberry Production

The production and cultural practices of highbush and rabbiteye blueberries are similar and for the purposes of this analysis will be considered together. Approximately 40,000 acres total of highbush and rabbiteye blueberries are in production in the U.S. Production is separated into 3 regions, North Central (MI, IN), East (NY, NJ, GA, NC, FL), and Pacific North (OR, WA) (see Table 7). On average, the East region produced 40% of the highbush blueberries followed closely by the North Central region with 39% and the Pacific North with 21%. Rabbiteye blueberry production is in the South, primarily in Georgia, Florida, and North Carolina, with approximately 6,200 acres in production in 2000. Both North Carolina and Georgia produce highbush and rabbiteye blueberry types.

Table 7. Highbush Blueberry Production and the Value of Production in the U.S. by Region and Major State in each Region [1]

Region/State	Harvested Acreage (Acres)	Production (1000 Pounds)	Percent of U.S. Production	Percent of Region Production	Value of Production ($1000)
U.S.	39,200	161,105	–	–	$130,605
North Central Region [2]	17,300	62,450	39%		$45,122
Michigan	16,500	59,500	37%	95%	$42,460
East Region [3,4]	17,700	65,215	40%	–	$63,554
New Jersey	7,500	37,500	23%	58%	$32,475
New York	700	1,550	1%	2%	$1,635
Florida	1,200	1,725	1%	3%	$6,628
Georgia	4,400	9,250	6%	14%	$7,928
North Carolina	3,100	13,600	8%	21%	$13,196
Pacific North Region	4,200	33,440	21%		$21,929
Oregon	2,600	22,750	14%	68%	$14,730

Region/State	Harvested Acreage (Acres)	Production (1000 Pounds)	Percent of U.S. Production	Percent of Region Production	Value of Production ($1000)
Washington	1,600	10,690	7%	32%	$7,199

1. Source: USDA/NASS Non-citrus Fruits and Nuts 2000 Preliminary Summary.
2. States in the North Central region include (% of U.S. production, % of regional production): Indiana (2%, 5%).
3. Rabbiteye production on approximately 6,200 acres in the East Region. Estimates include both highbush and rabbiteye blueberry production (Georgia (89% rabbiteye, 11% highbush); and North Carolina (75% highbush, 25% rabbiteye)).
4. Other States in the East region include (% of U.S. production, % of regional production): Alabama (0%, 2%), Arkansas (1%, 4%).

United States highbush blueberry production and value of production by end use market for the major regions and states in these regions is listed in Table 8. Total U.S. production is evenly split between fresh and processed, with slightly more production distributed to the processed market. This is not the case for each region - the destination of production in the East region averages more than 70% for the fresh market and less than 30% for the processed market, and the destination of production for the North Central and Pacific North regions is just the opposite, with more than 70% destined for the processed market and less than 30% destined for the fresh market.

Table 8. Highbush Blueberry Production and the Value of Production in the U.S. by End Use Market for each Region and Major State in each Region [1, 2]

Region/State	Production (1000 Pounds)			Value of Production ($1000)		
	Total	Fresh	Processed	Total	Fresh	Processed
U.S.	161,105	76,135	84,970	$130,605	$81,230	$49,374
North Central Region [3]	62,450	19,000	43,450	$45,122	$19,160	$25,962
Michigan	59,500	17,000	42,500	$42,460	$17,050	$25,410
East Region [4]	65,215	47,635	17,580	$63,554	$53,309	$10,245
New Jersey	37,500	28,000	9,500	$32,475	$26,460	$6,015
New York	1,550	1,400	150	$1,635	$1,509	$126
Florida	1,725	1,400	325	$6,628	$6,420	$208
Georgia	9,250	5,000	4,250	$7,928	$5,500	$2,428
North Carolina	13,600	10,400	3,200	$13,196	$11,836	$1,360
Pacific North Region	33,440	9,500	23,940	$21,929	$8,763	$13,167
Oregon	22,750	7,750	15,000	$14,730	$6,818	$7,913
Washington	10,690	1,750	8,940	$7,199	$1,945	$5,254

1. Source: USDA/NASS Non-citrus Fruits and Nuts 2000 Preliminary Summary.
2. Production by end use market not separated into highbush and rabbiteye blueberries. Estimates are only for highbush blueberries.
3. Other states in the North Central region include: Indiana.
4. Other states in the East region include: Alabama, Arkansas.

Highbush Blueberry Cultural Practices

Blueberries require fairly specific soil and climatic conditions for optimal production. Two-year old plants are generally established 3 to 5 feet apart in rows 10 to 12 feet apart. No crop will be harvested for the first two years and fields will produce increasingly larger crops until full production is reached 8 to 10 years after establishment. Well-maintained blueberry bushes remain productive for at least 15 to 20 years. Mature plants range in height from less than 3 feet for certain hybrids to 6 to 8 feet for most common commercial highbush varieties. Irrigation is important because blueberry root systems are shallow and lack root hairs; this puts them at a disadvantage when soils dry out. Overhead irrigation is also important to mediate spring frosts. Spring frosts are probably the major factor in determining the total production of blueberries for a region in any given year. Annual pruning of dead wood and older canes maintains plant vigor, reduces fruit numbers, permits light penetration, eliminates disease innoculum, and reduces populations of certain mite and scale pests. Pruning most often occurs in the winter months or in early spring.

Applying mulch in a 3 to 4 foot band centered under the plant encourages moisture retention, controls weeds and promotes root growth at the soil/mulch interface. Mulch should be replenished every two to three years so that roots do not become exposed. Mulch is often applied in the spring or early summer. Mowing or discing between rows is a common practice to maintain an appropriate ground cover. Occasionally hand weeding is necessary to control weeds in the plant rows.

The harvest period for highbush blueberries extends for upwards of 6 weeks with 3-5 consecutive harvests on as short as 5-day intervals. The harvest season depends on a number of factors with the most important being the variety and the climate of a particular production area. The harvest season begins about May 10 in North Carolina, June 10 in New Jersey, July 5 in Oregon and Washington, and July 10 in Michigan. In the East region, where greater than 70% of the crop is sold in the fresh market, hand picking is predominantly used. The remaining production is sold on the process market (<30%) and is generally machine harvested. The reverse is true in the North Central and Pacific North regions where 70% of production is processed and generally machine harvested and 30% is hand harvested for the fresh market. Most acreage is hand harvested for the first several pickings with the later harvests generally done by machine. Therefore, essentially 100% of the highbush blueberry acreage is both hand harvested and machine harvested.

Azinphos-methyl and Phosmet Usage and Target Pests on Highbush Blueberries

Azinphos-methyl and Phosmet Usage

Nationally, the USDA/NASS estimates that 39% of the highbush/rabbiteye blueberry crop is treated with phosmet annually (see Table 9). The North Central region consumed 73% of the phosmet used on blueberries in terms of pounds applied. Usage in the East accounted for 36% of the total pounds applied to blueberries, and the Pacific North used <1%.

Table 9. Usage of Phosmet on Highbush/Rabbiteye Blueberries by Region and Major State [1]

Region/ State	Percent of Crop Treated	Base Acres Treated (1000 acres) [2]	Use Rates (lbs. a.i./A)	Average # of Applications/Yr.	Total Pounds Applied (1000 lbs)
U.S.	39%	15	0.90	2	25
North Central Region	54%	9	0.91	2	16
Michigan	56%	9	0.91	2	16
East Region	22%	4	0.86	2	9
New Jersey	37%	3	0.86	2	5

Region/ State	Percent of Crop Treated	Base Acres Treated (1000 acres) [2]	Use Rates (lbs. a.i./A)	Average # of Applications/Yr.	Total Pounds Applied (1000 lbs)
New York	75%	<1	NA	NA	2
Florida	8%	<1	NA	NA	<1
Georgia	11%	<1	NA	NA	1
North Carolina	0%	0	–	–	0
Pacific North	–	–	–	–	
Oregon	1%	<1	NA	NA	<0.5
Washington	NA				

1. Source: USDA/NASS Fruit and Nut Chemical Use, 1997 and 1999, USDA New York Crop Profile for Blueberries and National Center for Food and Agricultural Policy database for Florida and Oregon (1997).
2. Base acres treated calculated using estimates of percent of crop treated and harvested acreage.
NA = information not available in EPA databases.

Table 10 lists the usage of azinphos-methyl on highbush blueberries by region and for the major states in each region. On average, an estimated 48% of the U.S. highbush blueberry acreage is treated with azinphos-methyl per year, and 15,000 pounds of azinphos-methyl are applied. Usage of azinphos-methyl on highbush blueberries is highest in the North Central region, where 76% of the highbush blueberry acreage is treated with azinphos-methyl. Twenty three percent of the East region highbush blueberry acreage is treated with azinphos-methyl, and azinphos- methyl usage in the Pacific North region on highbush blueberries is not estimated because usage data is not available for Washington. However, no usage of azinphos-methyl is estimated on highbush blueberries in Oregon.

Table 10. Usage of Azinphos-methyl on Highbush Blueberries by Region and Major State [1]

Region/ State	Percent of Crop Treated	Base Acres Treated (1000 acres) [2]	Average Use Rates (lbs. a.i./A)	Average # of Applications/Yr	Total Pounds Applied (1000 lbs)
U.S.	48%	17	0.53	2	15
North Central	76%	12	0.54	2	11
Michigan	76%	12	0.54	2	11
East	22%	4	0.53	2	<1
New Jersey	39%	3	NA	NA	3
New York	50%	<1	NA	NA	1
Florida	NA				
Georgia	0%	0	–	–	0
North Carolina	20%	<1	2	0.36	<1
Pacific North	–	–	–	–	–

Region/ State	Percent of Crop Treated	Base Acres Treated (1000 acres) [2]	Average Use Rates (lbs. a.i./A)	Average # of Applications/Yr	Total Pounds Applied (1000 lbs)
Oregon	0%	0	–	–	0
Washington	NA				

1. Source: USDA/NASS Fruit and Nut Chemical Use, 1997 and 1999, USDA New York blueberry crop profile.
2. Base acres treated calculated using percent of crop treated estimates and harvested acreage from Table 1.
NA = information not available in EPA databases.

Azinphos-methyl is often used during the early part of the season in all growing areas because of its longer PHI than phosmet. The first application generally occurs shortly after petal fall (April) with subsequent applications occurring as needed up to the beginning of the harvest period. Phosmet is more often utilized just before and during the harvest period because it has a short PHI (3-days) and it is very effective for the primary pests infesting blueberries during this time, Japanese beetle and blueberry maggot.

Target Pests

There is some regional specificity in regards to pests on highbush blueberries. In general, however, the primary target pests of azinphos-methyl and phosmet on highbush blueberries are fruitworms (including cranberry fruitworm and cherry fruitworm), blueberry maggot, and Japanese beetles. Secondary pests include obliquebanded leafrollers, plum curculio and spanworm (Blueberry Pest Management Strategic Plan). There are distinct similarities between the North Central and East regions when considering the primary target pests for applications of azinphos-methyl and phosmet.

The Japanese beetle (*Popillia japonica*) has in recent years become a serious pest in the North Central region and has somewhat decreased in importance in the East. There is one generation per year. Larvae, or grubs, develop in pastures, lawns and other turf areas, and crop land, where they live in the soil and feed on roots. Adults begin emerging in June and feed on the upper surface of blueberry foliage and on the fruit. Adults cause significant direct and indirect yield loss via feeding injury to the berries and associated decay from fruit rotting pathogens. There is a zero tolerance for Japanese beetles in processing blueberries. The adults are hard to remove because they are similar in weight and size to blueberries and they easily contaminate machine-harvested berries. Adults are very mobile and can quickly re-infest treated fields. Several applications per season, particularly in the the North Central region, of phosmet are applied.

Blueberry maggot (*Rhagoletis mendax* Curran) is also a direct berry pest and is generally considered the most serious pest of blueberry production in the East. This pest overwinters in the pupa stage in the soil with adults emerging over a prolonged period from June to August. There are similar consequences in highbush blueberries as that previously described for lowbush blueberries.

The fruitworm complex, cherry fruitworm (*Grapholitha packardi* Zeller) and the cranberry fruitworm (*Acrobasis vaccinii*) are serious direct fruit pests of blueberries in the East, North Central, and Pacific North regions. Some fields have suffered 50 to 75% losses of fruit, with earlier maturing varieties usually being the most infected. There is a zero tolerance for infested fruit in marketing channels. Infested berries may be harvested without detection, resulting in inspectors or consumers finding larvae in packaged berries. Adult females of both species lay eggs individually on the top of berries immediately following petal fall in the late spring. The larvae feed on berries internally and can move from one berry to another in a fruit cluster. There is only one generation per year.

Potential Pest Control Alternatives

For fruitworms, alternatives to azinphos-methyl and phosmet include *Bt*, tebufenozide, malathion, diazinon, esfenvalerate, carbaryl, and methomyl. For blueberry maggots alternatives to azinphos-methyl and phosmet include malathion, diazinon, esfenvalerate, carbaryl, and methomyl. For Japanese beetle alternatives include malathion, methomyl, carbaryl, esfenvalerate, and imidacloprid. While all of these compounds can provide some level of control of one or more of the target pests, none of these alternatives control the broad spectrum of pests that azinphos-methyl and phosmet control. Some of these compounds can lead to secondary pest outbreaks as well. Below is a detailed summary of each potential pest control alternative to azinphos-methyl and phosmet.

- *Bacillus thuringiensis* (*Bt*) (several products available) - primarily used during bloom time to control fruitworm larvae. Also effective against larvae of leafrollers. Timing and complete coverage is critical. Short residual control and effectiveness is weather dependent. 4 hour REI and 0-day PHI.
- Tebufenozide (Confirm) - good to excellent control of the fruitworms. Currently used during bloom time because it is safe to pollinators, but also can be used after petal fall. Not likely to be used close to or during harvest period because of its long PHI. Much more expensive than azinphos-methyl and phosmet. 4 hour REI and 14-day PHI.
- Malathion (many products) - excellent to good control of blueberry maggot but not as effective on Japanese beetle. When used at full rate will provide only 1 to 2 days of Japanese beetle control. Can be used during harvest period because of its short PHI, but not used as frequently as phosmet because of its short residual. 12 hour REI and 0- or 1-day PHI depending on formulation used.
- Diazinon - provides control of all pests except Japanese beetle, but there are concerns about resistance in leafrollers, particularly in Michigan. Offers residual control of up to 14 days, and has a 24 hour REI and a PHI of 7 days. The relatively long PHI makes it unlikely that this chemical will be used against the late-season pests, such as blueberry maggot.
- Esfenvalerate - this synthetic pyrethroid can provide good to excellent control of fruitworms and leafrollers, as well as adequate control of blueberry maggot, but is unlikely to be very effective against Japanese beetle (at present, it is not labeled as controlling this or any other beetle species). It has a short REI (12 hours), but a relatively long PHI (7 days), which adds to the low attractiveness of this insecticide as a control option for late-season pests. Its comparatively low cost suggests that it is a good option for fruitworm and mid-season blueberry maggot control.
- Carbaryl (Sevin) - provides good control of all pests important in this crop, and has a short REI (12 hours). In addition, it has relatively low toxicity to fish and mammals. However, its long PHI (7 days) currently makes it an unattractive choice close to harvest. It can also stimulate aphid buildups.
- Methomyl (Lannate) - this carbamate provides good control of Lepidopteran pests (particularly leafrollers) and blueberry maggot, and also controls aphids. It is not as effective on Japanese beetle, however. It has an REI of 48 hours and a PHI of 3 days. These short intervals, along with its relative effectiveness against different insects, means it is a potentially good alternative for blueberry maggot control but not for Japanese beetle. An additional restriction on the use of this chemical is a prohibition for self-picked (“U-picked”) fields.
- Imidacloprid (Admire and Provado) - a member of the new class of neonictinoid insecticides, this chemical is currently registered in New Jersey and Michigan under Section 18 exemptions. Provado is the formulation that can be applied to foliage, while Admire can be applied to the ground so as to be effective in plants systemically. In Michigan only Provado is exempted at the moment. This chemical is effective against both larval and adult forms of the Japanese beetle when applied to the ground, but is only lethal to adults as a contact poison when applied as a foliar insecticide (however, “knockdown” or sub-lethal effects can persist for upto 10 days). It has a 48 hour REI and a 3 day PHI, which make it potentially attractive for late-season use against this pest. However, while Section 3 permission for its use is expected for New Jersey, use in Michigan is only permitted for the 2001 growing season at present.

Restricted Entry and Pre-harvest Intervals

Current label REIs for azinphos-methyl are 4 days (5 days in areas receiving less than 25 inches of rainfall per year) and the PHI is 7 days. Please refer to the occupational and residential human health risk assessment on the Agency’s website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for this chemical.

The current label REI for phosmet is 1 day, and the PHI is 3 days. The phosmet registrant has proposed a 7 day restricted entry interval for all activities. Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for this chemical.

Impacts of Potential REI Extensions for Azinphos-methyl and Phosmet on Highbush Blueberry Production

Scenarios

Based on available information, BEAD has attempted to quantify impacts associated with extending post-application reentry intervals for azinphos-methyl and phosmet on highbush blueberries. To complete this task, we developed three hypothetical mitigation scenarios with the aim at assessing the individual benefits of the use of azinphos-methyl and phosmet:

- Scenario 1 - Azinphos-methyl REI less than or equal to 7 days, and phosmet REI >3 days. Phosmet would no longer be used by growers.
- Scenario 2 - Azinphos-methyl REI >7 days, and phosmet REI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.
- Scenario 3 - Azinphos-methyl REI > 7 days, and phosmet REI > 3 days. Both azinphos-methyl and phosmet would no longer be used by growers.

For the three regions, Pacific North, North Central, and East, BEAD has developed alternate pest control regimes appropriate for the hypothetical scenario and estimated potential yield and quality impacts that growers may experience.

Pacific North Region

For the Pacific North we have estimated that there would be a negligible impact on growers if the REIs were extended for azinphos-methyl and phosmet. Regardless of which scenario is assessed, there is such little use of both these insecticides in Pacific North Region that we assumed little or no impact if they were no longer available.

North Central Region

Currently in the North Central Region growers use on average 2 applications of azinphos-methyl and 2 applications of phosmet per growing season.

- Scenario 1 - Azinphos-methyl REI less than or equal to 7 days, and phosmet REI >3 days. Phosmet would no longer be used by growers.

Assumptions -

5. Alternate Pest Control Program -
    a. 2 additional applications of methomyl - will be used because of its 3 day PHI even though it is only marginally effective against Japanese beetle.
    b. 1 additional application of malathion - because of it's 12 hour REI and 1 day PHI it will likely be used in situations where a grower is close to harvest.

c. 1 additional application of imidacloprid - if Section 18 exemptions continue imidacloprid will be used for adult beetle control during the harvest period; however, it is quite expensive.

6. No Yield Loss -
   a. Rationale - assumed alternative pest controls would not reduce plant yields.
7. Quality Losses -
   a. 3 - 5% of production would shift from fresh market to the process market because of poorer quality fruit and potential insect contamination.
   b. 5 - 15% of production would shift from the process market to no sale because of potential insect contamination and loads being rejected by the processor or buyer.

- Scenario 2 - Azinphos-methyl REI >7 days, and phosmet REI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.

  Assumptions -
  1. Alternate Pest Control Program -
     a. 1 additional application of tebufenozide - for control of fruitworm and leafroller larvae
     b. 1 additional application of carbaryl - for early season blueberry maggot control
     c. 1 additional application of esfenvalerate - for early season blueberry maggot control and supplemental fruitworm and leafroller larval control
  2. No Yield Loss -
     a. Rationale - assumed alternative pest control program would not reduce plant yields
  3. Quality Losses -
     a. 1 - 2% of production would shift from fresh market to the process market because of poorer quality fruit and potential insect contamination.
     b. 1 - 2% of production would shift from the process market to no sale because of potential insect contamination and loads being rejected by the processor or buyer.

- Scenario 3 - Azinphos-methyl REI > 7 days, and phosmet REI > 3 days. Both azinphos-methyl and phosmet would no longer be used by growers.

  Assumptions -
  1. Alternate Pest Control Program - for reasons stated above, the following pest control treatment regime will likely be used
     a. 1 additional application of tebufenozide
     b. 1 additional application of esfenvalerate
     c. 1 additional application of carbaryl
     d. 2 additional applications of methomyl
     e. 1 additional application of malathion
     f. 1 application of imidacloprid
  2. No Yield Loss -
     a. Rationale - assumed alternative pest control program would not reduce plant yields.
  3. Quality Losses -
     a. 5 - 7% of production would shift from fresh market to the process market because of poorer quality fruit and potential insect contamination.
     b. 10 - 15% of production would shift from the process market to no sale because of potential insect contamination and loads being rejected by the processor or buyer.

East Region

Currently in the East Region growers use on average 2 applications of azinphos-methyl and 2 applications of phosmet per growing season.

- Scenario 1 - Azinphos-methyl REI less than or equal to 7-days, and phosmet REI >3 days. Phosmet would no longer be used by growers.

  Assumptions -

  1. Alternate Pest Control -
     a. 2 additional applications of methomyl - will be used because of its 3 day PHI and its effectiveness on blueberry maggot even though it is only marginally effective against Japanese beetle.
     b. 2 additional applications of malathion - because of it's 12 hour REI and 1 day PHI it will likely be used in situations where a grower is close to harvest.
  2. No Yield loss -
     a. Rationale - assumed alternative pest control program would not reduce plant yields.
  3. Quality Losses -
     a. 5 - 10% of production would shift from fresh market to the process market because of poorer quality fruit and potential insect contamination.
     b. 10 - 15% of production would shift from the process market to no sale because of potential insect contamination and loads being rejected by the processor or buyer.

- Scenario 2 - Azinphos-methyl REI >7 days, and phosmet REI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.

  Assumptions -

  1. Alternate Pest Control Program -
     a. 1 additional application of carbaryl - for early season blueberry maggot control
     b. 1 additional application of tebufenozide - for control of fruitworm and leafroller larvae
     c. 1 additional application of esfenvalerate - for early season blueberry maggot control and supplemental fruitworm and leafroller larval control
  2. No Yield loss -
     a. Rationale - assumed alternative pest control program would not reduce plant yields.
  3. Quality Losses -
     a. 1 - 2% of production would shift from fresh market to the process market because of poorer quality fruit and potential insect contamination.
     b. 1 - 2% of production would shift from the process market to no sale because of potential insect contamination and loads being rejected by the processor or buyer.

- Scenario 3 - Azinphos-methyl REI > 7 days, and phosmet REI > 3 days. Both azinphos-methyl and phosmet would no longer be used by growers.

  Assumptions -

  1. Alternate Pest Control Program - for reasons stated above, the following pest control treatment regime will likely be used
     a. 2 additional applications of methomyl
     b. 2 additional applications of malathion
     c. 1 additional application of esfenvalerate
     d. 1 additional application of carbaryl
     e. 1 additional application of tebufenozide
  2. No Yield loss -
     a. Rationale - assumed alternative pest control program would not reduce plant yields.
  3. Quality Losses -
     a. 5 - 10% of production would shift from fresh market to the process market because of poorer quality fruit and potential insect contamination.

b. 10 - 15% of production would shift from the process market to no sale because of potential insect contamination and loads being rejected by the processor or buyer.

Grower Level Impacts

The following section summarizes the estimated impacts of extending the REIs of azinphos-methyl and phosmet on grower level net revenues. For this assessment, net revenue is considered operating net revenue. That is, the assessment only considers the impacts of extending the REIs of phosmet and azinphos-methyl on the blueberry growers ability to meet operating expenses. Net revenue is defined as revenue minus cost, where revenue equals the quantity produced multiplied times the price received by growers, and cost equals the farm level operating (or variable) cost of production.

Tables 11 and 12 list the impacts at the grower level of changing the REIs of azinphos-methyl and phosmet on blueberries in the North Central Region and East Region, respectively. The impacts of three potential scenarios are estimated. Each scenario represents a different set of REIs for azinphos-methyl and phosmet. Impacts are expected to be different depending on the scenario. The first row in each table lists the current yield, prices, revenues, costs and net revenues for blueberries in each region. The second through fifth rows in each table list the estimate of impacts of changing the REIs of azinphos-methyl and phosmet as defined in each scenario. The net loss estimate (bolded) in the last column of each scenario is the difference between current net revenues and the estimated net revenues expected as a result of each scenario. (Please see the General Assumptions section for a more complete discussion of the impacts.)

North Central Region (Table 11)

- The estimated impact of not having phosmet available for use on blueberries in the North Central Region (scenario 1) is a reduction in grower net revenues to $845 to $1,004 per acre, which is a decline of 10% to 25% from current net revenues ($1,120 per acre).
- The estimated impact of not having azinphos-methyl available for use on blueberries in the North Central Region (scenario 2) is a reduction in grower net revenues to $1,074 to $1,094 per acre, which is a decline of 2% to 4% from current net revenues ($1,120 per acre).
- The estimated impact of not having phosmet and azinphos-methyl available for use on blueberries in the North Central Region (scenario 3) is a reduction in grower net revenues to $829 to $912 per acre, which is a decline of 19% to 26% from current net revenues ($1,120 per acre).

Table 11. Summary of North Central Region Highbush Blueberry Grower Level Impacts [1]

Scenario	Yield	Quality Impact (Price)	Revenues	Operating Costs	Net Revenues
Current Situation	Current total: Total: 3,610 lbs/A Fr: 1,100 lbs/A Proc: 2,510 lbs/A	Prices: Total: $0.72/lb Fr: $1.00/lb Proc: $0.60/lb	Current: $2,605/A	Current: $1,485/A	Current: $1,120/A
1 REIs: Azinphos-methyl: =/<7 days Phosmet: >3 days	Yield loss: None	Quality Loss: Fr to Proc: 3-5% Proc to no sale: 5-15% Fr New Total: 1,045 - 1,067 lbs/A Proc New Total: 2,189 - 2,417 lbs/A No Sale New Total: 126 - 376 lbs/A	New: $2,358/A to $2,517/A	New: $1,513/A	New: $845/A to $1,004/A **Net Loss:** $116/A to $275/A
2 REIs: Azinphos-methyl: >7 days Phosmet: =/<3 days	Yield loss: None	Quality Loss: Fr to Proc: 1-2% Proc to no sale: 1-2% Fr New Total: 1,078 - 1,089 lbs/A Proc New Total: 2,482 - 2,496 lbs/A No Sale New Total: 25 - 50 lbs/A	New: $2,567/A to $2,587/A	New: $1,493/A	New: $1,074/A to $1,094/A **Net Loss:** $26/A to $46/A
3 REIs: Azinphos-methyl: >7 days Phosmet: >3 days	Yield loss: None	Quality Loss: Fr to Proc: 5-7% Proc to no sale:10-15% Fr New Total: 1,023 -1,045 lbs/A Proc New Total: 2,211 - 2,314 lbs/A No Sale New Total: 251 -376 lbs/A	New: $2,350/A to $2,433/A	New: $1,521/A	New: $829/A to $912/A **Net Loss:** $208/A to $291/A

1. See General Assumptions section for a discussion of the assumptions and calculations.

East Region (Table 12)

- The estimated impact of not having phosmet available for use on blueberries in the East Region (scenario 1) is a reduction in grower net revenues to $1,275 to $1,372 per acre, which is a decline of 9% to 15% from current net revenues ($1,505 per acre).
- The estimated impact of not having azinphos-methyl available for use on blueberries in the East Region (scenario 2) is a reduction in grower net revenues to $1,457 to $1,476 per acre, which is a decline of 2% to 3% from current net revenues ($1,505 per acre).
- The estimated impact of not having phosmet and azinphos-methyl available for use on blueberries in the East Region (scenario 3) is a reduction in grower net revenues to $1,267 to $1,364 per acre, which is a decline of 9% to 16% from current net revenues ($1,505 per acre).

Table 12. Summary of East Region Highbush Blueberry Grower Level Impacts [1]

Scenario	Yield	Quality Impact (Price)	Revenues	Costs	Net Revenues
Current Situation	Current total: Total: 3,685 lbs/A Fr: 2,765 lbs/A Proc: 920 lbs/A	Prices: Total: $0.98/lb Fr: $1.10/lb Proc: $0.60/lb	Current: $3,595/A	Current: $2,090/A	Current: $1,505/A
1 REIs: Azinphos-methyl: =/<7 days Phosmet: >3 days	Yield loss: None	Quality Loss: Fr to Proc: 5-10% Proc to no sale: 5-15% Fr New Total: 2,489 - 2,627 lbs/A Proc New Total: 966 - 1,058 lbs/A No Sale New Total: 92 - 138 lbs/A	New: $3,373/A to $3,470/A	New: $2,098/A	New: $1,275/A to $1,372/A **Net Loss:** $138/A to $230/A
2 REIs: Azinphos-methyl: >7 days Phosmet: =/<3 days	Yield loss: None	Quality Loss: Fr to Proc: 1-2% Proc to no sale: 1-2% Fr New Total: 2,710 - 2,737 lbs/A Proc New Total: 939 - 957 lbs/A No Sale New Total: 9 - 18 lbs/A	New: $3,555/A to $3,574/A	New: $2,098/A	New: $1,457/A to $1,476/A **Net Loss:** $29/A to $48/A
3 REIs: Azinphos-methyl: >7 days Phosmet: >3 days	Yield loss: None	Quality Loss: Fr to Proc: 5-10% Proc to no sale: 5-15% Fr New Total: 2,049 - 2,627 lbs/A Proc New Total: 966 - 1,058 lbs/A No Sale New Total: 92 - 138 lbs/A	New: $3,373/A to $3,470/A	New: $2,106/A	New: $1,267/A to $1,364/A **Net Loss:** $141/A to $238/A

1. See General Assumptions section for a discussion of the assumptions and calculations.

Regional Level Impacts

The following section summarizes the estimated impacts of extending the REIs of azinphos-methyl and phosmet on regional level net revenues. Regional net revenues are calculated by aggregating up from the grower level in each region, taking into account acres grown and the percent of acres treated with azinphos-methyl and phosmet (depending on the scenario) in each region.

Table 13 lists the impacts at the grower level of changing the REIs of azinphos-methyl and phosmet on blueberries in the North Central Region and East Region. The impacts of three potential scenarios are estimated. Each scenario represents a different set of REIs for azinphos-methyl and phosmet. Impacts are expected to be different depending on the scenario. The current regional net revenues (current total) and estimated net revenues as a result of extending the REIs of azinphos-methyl and phosmet (new total) are estimated in the table. The net loss estimate (bolded) in the last column of each scenario is the difference between current net revenues and the estimated net revenues expected as a result of each scenario. (Please see the General Assumptions section for a more complete discussion of the impacts.)

North Central Region

- The estimated impact of not having phosmet available for use on blueberries in the North Central Region (scenario 1) is a reduction in regional net revenues of 6% to 13% from current regional net revenues.

- The estimated impact of not having azinphos-methyl available for use on blueberries in the North Central Region (scenario 2) is a reduction in regional net revenues of 2% to 3% from current regional net revenues.

- The estimated impact of not having phosmet and azinphos-methyl available for use on blueberries in the North Central Region (scenario 3) is a reduction in regional net revenues of 13% to 19% from current regional net revenues.

East Region

- The estimated impact of not having phosmet available for use on blueberries in the East Region (scenario 1) is a reduction in regional net revenues of 2% to 3% from current regional net revenues.

- The estimated impact of not having azinphos-methyl available for use on blueberries in the East Region (scenario 2) is a reduction in regional net revenues of 1% from current regional net revenues.

- The estimated impact of not having azinphos-methyl and phosmet available for use on blueberries in the East Region (scenario 3) is a reduction in regional net revenues of 2% to 3% from current net revenues.

Table 13. Summary of North Central Region and East Region Highbush Blueberry Regional Level Impacts [1]

Scenario	Region	Net Revenues
1 REIs: Azinphos-methyl: =/<7 days Phosmet: >3 days	North Central	Current total: \$19.4 million New Total: \$16.8 to \$18.3 million **Net Loss:** \$1.1 to \$2.6 million
	East	Current total: \$26.6 million New Total: \$25.8 to \$26.1 million **Net Loss:** \$0.5 to \$0.8 million
2 REIs: Azinphos-methyl: >7 days Phosmet:: =/<3 days	North Central	Current total: \$19.4 million New Total: \$18.8 to \$19 million **Net Loss:** \$0.4 to \$0.6 million
	East	Current total: \$26.6 million New Total: \$26.4 to \$26.5 million **Net Loss:** \$0.1 to \$0.2 million
3 REIs: Azinphos-methyl: >7 days Phosmet: >3 days	North Central	Current total: \$19.4 million New Total: \$15.7 to \$16.8 million **Net Loss:** \$2.6 to \$3.7 million
	East	Current total: \$26.6 million New Total: \$25.7 to \$26.1 million **Net Loss:** \$0.5 to \$0.9 million

1. See General Assumptions section for a discussion of the assumptions and calculations.

GENERAL ASSUMPTIONS

General Assumptions and Quantitative Impacts

The following is a description of the assumptions made in calculating the quantitative impacts on blueberry grower revenues, costs, and net revenues (profits) of extending the restricted entry intervals (REIs) for phosmet and azinphos-methyl on blueberries, and of the estimates of blueberry grower revenues, costs, and net revenues as a result of extending the REIs for phosmet and azinphos-methyl on blueberries.

Impacts are estimated for one scenario in lowbush blueberries and three scenarios in highbush blueberries (North Central and East Regions) as defined below. Each scenario represents a different combination of phosmet and azinphos-methyl REIs, with the assumption made that for any REI longer than 3 days for phosmet and 7 days for azinphos-methyl, blueberry growers could suffer impacts to their revenues received and/or costs of production. Impacts are measured in terms of the effect of changing azinphos-methyl and phosmet REIs (as set out in each scenario) on per acre grower revenues, costs, and net revenues. The grower level estimates of net revenues are aggregated up to a regional level, taking into account blueberry acres grown and blueberry acres treated with azinphos-methyl and phosmet (depending on the scenario) in each region.

For this assessment, net revenue is considered operating net revenue. That is, the assessment only considers the impacts of extending the REIs of phosmet and azinphos-methyl on the blueberry growers ability to meet operating expenses. Net revenue is defined as revenue minus cost, where revenue equals the quantity produced multiplied times the price received by growers, and cost equals the farm level operating (or variable) cost of production.

Revenues are impacted through changes in yield and quality. Changes in yield effect the quantity of fruit produced, and changes in quality effect the end use market of the fruit produced (fresh vs. processed vs. no sale) and, therefore, the price received for the fruit produced. Costs are impacted through changes in the chemical cost of pest control. It is assumed that fruit yield and quality, and the chemical cost of pest control will change as a result of extending the REIs of azinphos-methyl and phosmet, as growers move to less effective and more expensive chemical alternatives than phosmet and azinphos-methyl.

The estimates of impacts to yield, price, and cost were assumed based on the available information. The estimates of current production, yield, and price are based on production and price data published in USDA's Noncitrus Fruits and Nuts 2000 Preliminary Summary. The estimates of current operating (variable) cost by region are based on enterprise budgets for Maine blueberry production (for lowbush blueberries), Michigan blueberry production (for North Central Region highbush blueberries), and Northeast blueberry production (for East Region highbush blueberries).

Assumptions and estimated impacts are provided by Region (i.e., Pacific North, North Central, and East Regions) and by scenario, with separate sections for grower and regional level impacts. Following the discussion of assumptions and impacts for lowbush and highbush blueberries is an impact summary section containing tables summarizing grower level impacts and regional level impacts by scenario.

Lowbush Blueberries (National)

<u>SCENARIO 1:</u>
Azinphos-methyl REI greater than 10 days. Phosmet REI less than or equal to 7 days. Blueberry growers would no longer use azinphos-methyl.

Grower Level Impacts

1. Assume if a grower is using azinphos-methyl and phosmet, they would treat every acre of blueberries on their farm with azinphos-methyl and phosmet.

2. Revenue Impact - f(yield, price (quality))

   Revenues are impacted through changes in yield and/or quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold.

   A. Assume for lowbush blueberries, yield is 2,150 pounds per acre, at a price of $0.48 per pound. Revenues are $1,040 per acre.

   B. Assume no impact on yield or quality.

3. Cost Impact

   A. Assume operating (variable) costs to be $580 per acre. The assessment is only focusing on operating costs. Fixed costs are $415 per acre, but are not included in this assessment.

   B. Assume a change in variable costs due to additional chemical control to replace the average of 2 applications of azinphos-methyl per season for blueberry maggot control.

      1. Assume 1 application of phosmet and 1 application of esfenvalerate. Additional cost of $32 per acre.

   C. Assume variable costs increase $6 to $586 per acre (2 applications of azinphos-methyl cost an estimated $26 per acre).

4. Net Revenue (Profit) Impacts

   A. Assume that current revenues are equal to $1,040 per acre, costs are $580 per acre, and net revenues are $460 per acre.

   B. Assume without azinphos-methyl revenues remain $1,040, and costs increase to $586 per acre. Net revenues equal $454 per acre - a decline of 1%.

   C. Assume that total current farm net revenues are $19,320 (an average of 42 acres per farm with net revenues of $460 per acre) in Maine from blueberry production.

   D. Assume per farm net revenues decline to $19,068 (42 acre per farm with net revenues of $454 per acre) - a decline of 1% - per farm with the loss of azinphos-methyl.

National/Regional Level Impacts

1. Net Revenue (Profit) Impacts

   A. Assume that current revenues are equal to $1,040 per acre, costs are $580 per acre, and net revenues are $460 per acre. Assume 30,000 acres of blueberries harvested per year in Maine. Assume net revenues of $1.8 million in Maine from growing blueberries.

   B. Assume without azinphos-methyl revenues remain $1,040, and costs increase to $586 per acre. Net revenues equal $454 per acre.

   C. Assume 36% of Maine (National) blueberry acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (10,800 acres). The remaining 19,200 acres will not be impacted.

D. Assume net revenues of $13.7 million in Maine - a decline of 1% - in Maine producing blueberries without azinphos-methyl.

Impact Summary

Tables 14 and 15 summarize the grower and regional level impacts, respectively, of extending the REI of azinphos-methyl longer than 10 days on lowbush blueberries.

Table 14. Summary of Lowbush Blueberry Grower Level Impacts

Scenario	Yield	Quality Impact (Price)	Revenues	Operating Costs	Net Revenues
Current Situation	Current total: 2,150 lbs/A	Prices: $0.48/lb	Current: $1,040/A	Current: $580/A	Current: $460/A
Scenario: REIs: Azinphos-methyl: > 10 days	Yield loss: None	No Quality Change	No Change	New: $586/A	New: $454/A **Net Loss:** $6/A

Table 15. Summary of Lowbush Blueberry National Level Impacts

Scenario	Region	Net Revenues
Scenario: REIs: Azinphos-methyl: >10 days	National	Current total: $13.8 million New Total: $13.7 million **Net Loss:** $0.1 million

Highbush Blueberries

<u>North Central Region</u>

<u>SCENARIO 1:</u>
Azinphos-methyl REI less than or equal to 7 days. Phosmet REI greater than 3 days. Blueberry growers would no longer use phosmet.

Grower Level Impacts
1. Assume if a grower is using azinphos-methyl and phosmet, they would treat every acre of blueberries on their farm with azinphos-methyl and phosmet.

2. Revenue Impact - f(yield, price (quality))
Revenues are impacted through changes in yield and/or quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold.

A. Assume in the North Central production of 3,610 pounds of blueberries per acre, with a value of $2,605 per acre. This assumes 1,100 pounds per acre (30%) is destined for the fresh market (at a price of $1.00 per pound), and 2,510 pounds per acre (70%) is destined for the processed market (at a price of $0.60 per pound).

B. Assume no loss in yield without phosmet available.

C. Assume a quality loss in the blueberries produced as a result of damage caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the blueberries (i.e., fresh, processed, or no sale) and, therefore, the price received for production.

D. Assume the price received by growers for fresh market blueberries is equal to $1.00 per pound, and for processed market blueberries, $0.60 per pound. Also assume the potential change in price received for production is equal to $0 per pound (no change in end use market) to $0.60 per pound (change from processed market to no sale).

E. Assume, due to losses in the quality of the fruit, 3% to 5% of the current fresh blueberry production per acre goes to the processed market, and 5% to 15% of the current processed blueberry production per acre is not sold. Production destined for the fresh market declines to 1,045 to 1067 pounds per acre, and production destined for the processed market declines to 2,189 to 2,417 pounds per acre. The remaining 126 to 376 pounds per acre produced is not sold.

F. Assume the value of the fresh market production declines to $1,045 to $1,067 per acre, and the value of processed market production declines to $1,313, to $1,450 per acre. Revenues would equal $2,358 to $2,517 per acre - a decline of 3% to 10% from current per acre revenues of $2,605 per acre.

3. Cost Impact

A. Assume operating (variable) costs to be $1,485 per acre. The assessment is only focusing on operating costs. Fixed costs are $1,050 per acre, but are not included in this assessment.

B. Assume a change in variable costs due to additional insecticide control to replace the average of 2 applications of phosmet.

1. Assume 2 additional applications of methomyl, 1 application of malathion, and 1 application of imidacloprid for the control of target pests. Additional cost of $60 per acre.

C. Assume variable costs increase $28 (the current cost of 2 applications of phosmet is $32 per acre) from $1,485 per acre to $1,513 per acre - an increase of 2%.

4. Net Revenue (Profit) Impacts

Per Acre
A. Assume that current revenues are equal to $2,605 per acre, and costs are $1,485 per acre, resulting in net revenues of $1,120 per acre.

B. Assume revenues decline to $2,358 to $2,517 per acre, and costs increase to $1,513 per acre. Net revenues equal $845 to $1,004 per acre - a decline of 10% to 25% from current per acre net revenues.

Per Farm
C. Assume that total current farm profits equal $28,000 (an average of 25 acres per farm at net revenues of $1,120 per acre) in the North Central Region from blueberry production.

D. Assume per farm profits of $21,125 to $25,100 - a decline of 10% to 25% from current farm net revenues with the loss of phosmet for the production of blueberries in the North Central Region.

Regional Level Impacts

1. Net Revenue (Profit) Impacts

A. Assume that current revenues are equal to $2,605 per acre, and costs are $1,485 per acre, resulting in net revenues of $1,120 per acre. Assume 17,300 blueberry bearing acres grown in the North Central Region. Assume net revenues of $19.4 million in the North Central Region from growing blueberries.

B. Assume revenues decline to $2,358 to $2,517 per acre, and costs increase to $1,513 per acre. Net revenues equal $845 to $1,004 per acre.

C. Assume 54% of the North Central Region blueberry acreage treated with phosmet. Assume this is the acreage potentially impacted (9,342 acres). The remaining 7,958 acres will not be impacted.

D. Assume net revenues of $16.8 to $18.3 million in the North Central Region - a decline of 6% to 13% - in the North Central Region producing blueberries without phosmet.

<u>SCENARIO 2:</u>
Azinphos-methyl REI greater than 7 days. Phosmet REI less than or equal to 3 days. Blueberry growers would no longer use azinphos-methyl.

Grower Level Impacts

1. Assume if a grower is using azinphos-methyl and phosmet, they would treat every acre of blueberries on their farm with azinphos-methyl and phosmet.

2. Revenue Impact - f(yield, price (quality))

Revenues are impacted through changes in yield and/or quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold.

A. Assume in the North Central production of 3,610 pounds of blueberries per acre, with a value of $2,605 per acre. This assumes 1,100 pounds per acre (30%) is destined for the fresh market (at a price of $1.00 per pound), and 2,510 pounds per acre (70%) is destined for the processed market (at a price of $0.60 per pound).

B. Assume no loss in yield without azinphos-methyl available.

C. Assume a quality loss in the blueberries produced as a result of damage caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the blueberries (i.e., fresh, processed, or no sale) and, therefore, the price received for production.

D. Assume the price received by growers for fresh market blueberries is equal to $1.00 per pound, and for processed market blueberries, $0.60 per pound. Also assume the potential change in price received for production is equal to $0 per pound (no change in end use market) to $0.60 per pound (change from processed market to no sale).

E. Assume, due to losses in the quality of the fruit, 1% to 2% of the current fresh blueberry production per acre goes to the processed market, and 1% to 2% of the current processed blueberry production per acre is not sold. Production destined for the fresh market declines to 1,078 to 1,089 pounds per acre, and production destined for the processed market declines to 2,482 to 2,496 pounds per acre. The remaining 25 to 50 pounds per acre produced is not sold.

F. Assume the value of the fresh market production declines to $1,078 to $1,089 per acre, and the value of processed market production declines to $1,489, to $1,498 per acre. Revenues would equal $2,567 to $2,587 per acre - a decline of <1% from current per acre revenues of $2,605 per acre.

3. Cost Impact

A. Assume operating (variable) costs to be $1,485 per acre. The assessment is only focusing on operating costs. Fixed costs are $1,050 per acre, but are not included in this assessment.

B. Assume a change in variable costs due to additional insecticide control to replace the average of 2 applications of azinphos-methyl.

1. Assume 1 additional applications of tebufenozide, 1 application of carbaryl, and 1 application of esfenvalerate for the control of target pests. Additional cost of $34 per acre.

C. Assume variable costs increase $8 (the current cost of 2 applications of azinphos-methyl is $26 per acre) from $1,485 per acre to $1,493 per acre - an increase of 1%.

4. Net Revenue (Profit) Impacts

Per Acre
A. Assume that current revenues are equal to $2,605 per acre, and costs are $1,485 per acre, resulting in net revenues of $1,120 per acre.

B. Assume revenues decline to $2,567 to $2,587 per acre, and costs increase to $1,493 per acre. Net revenues equal $1,074 to $1,094 per acre - a decline of 2% to 4% from current per acre net revenues.

Per Farm
C. Assume that total current farm profits equal $28,000 (an average of 25 acres per farm at net revenues of $1,120 per acre) in the North Central Region from blueberry production.

D. Assume per farm profits of $26,850 to $27,350 - a decline of 2% to 4% from current farm net revenues with the loss of azinphos-methyl for the production of blueberries in the North Central Region.

Regional Level Impacts

1. Net Revenue (Profit) Impacts

A. Assume that current revenues are equal to $2,605 per acre, and costs are $1,485 per acre, resulting in net revenues of $1,120 per acre. Assume 17,300 blueberry bearing acres grown in the North Central Region. Assume net revenues of $19.4 million in the North Central Region from growing blueberries.

B. Assume revenues decline to $2,567 to $2,587 per acre, and costs increase to $1,493 per acre. Net revenues equal $1,074 to $1,094 per acre.

C. Assume 72% of the North Central Region blueberry acreage treated with phosmet. Assume this is the acreage potentially impacted (12,456acres). The remaining 4,844 acres will not be impacted.

D. Assume net revenues of $18.8 to $19 million in the North Central Region - a decline of 2% to 3% - in the North Central Region producing blueberries without azinphos-methyl.

SCENARIO 3:
Azinphos-methyl REI greater than 7 days. Phosmet REI greater than 3 days. Blueberry growers would no longer use azinphos-methyl or phosmet.

Grower Level Impacts
1. Assume if a grower is using azinphos-methyl and phosmet, they would treat every acre of blueberries on their farm with azinphos-methyl and phosmet.

2. Revenue Impact - f(yield, price (quality))
Revenues are impacted through changes in yield and/or quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold.

A. Assume in the North Central production of 3,610 pounds of blueberries per acre, with a value of $2,605 per acre. This assumes 1,100 pounds per acre (30%) is destined for the fresh market (at a price of $1.00 per pound), and 2,510 pounds per acre (70%) is destined for the processed market (at a price of $0.60 per pound).

B. Assume no loss in yield without azinphos-methyl available.

C. Assume a quality loss in the blueberries produced as a result of damage caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the blueberries (i.e., fresh, processed, or no sale) and, therefore, the price received for production.

D. Assume the price received by growers for fresh market blueberries is equal to $1.00 per pound, and for processed market blueberries, $0.60 per pound. Also assume the potential change in price received for production is equal to $0 per pound (no change in end use market) to $0.60 per pound (change from processed market to no sale).

E. Assume, due to losses in the quality of the fruit, 5% to 7% of the current fresh blueberry production per acre goes to the processed market, and 10% to 15% of the current processed blueberry production per acre is not sold. Production destined for the fresh market declines to 1,023 to 1045 pounds per acre, and production destined for the processed market declines to 2,211 to 2,314 pounds per acre. The remaining 251 to 376 pounds per acre produced is not sold.

F. Assume the value of the fresh market production declines to $1,023 to $1,045 per acre, and the value of processed market production declines to $1,327 to $1,388 per acre. Revenues would equal $2,350 to $2,433 per acre - a decline of 7% to 10% from current per acre revenues of $2,605 per acre.

3. Cost Impact

A. Assume operating (variable) costs to be $1,485 per acre. The assessment is only focusing on operating costs. Fixed costs are $1,050 per acre, but are not included in this assessment.

B. Assume a change in variable costs due to additional insecticide control to replace the average of 2 applications of phosmet.

1. Assume 2 additional applications of methomyl, 1 application of malathion, 1 application of imidacloprid, 1 application of esfenvalerate, 1 application of carbaryl, and 1 application of tebufenozide for the control of target pests. Additional cost of $94 per acre.

C. Assume variable costs increase $36 (the current cost of 2 applications of phosmet and 2 applications of azinphos-methyl is $58 per acre) from $1,485 per acre to $1,521 per acre - an increase of 2%.

4. Net Revenue (Profit) Impacts

Per Acre
A. Assume that current revenues are equal to $2,605 per acre, and costs are $1,485 per acre, resulting in net revenues of $1,120 per acre.

B. Assume revenues decline to $2,350 to $2,433 per acre, and costs increase to $1,521 per acre. Net revenues equal $829 to $912 per acre - a decline of 19% to 26% from current per acre net revenues.

Per Farm
C. Assume that total current farm profits equal $28,000 (an average of 25 acres per farm at net revenues of $1,120 per acre) in the North Central Region from blueberry production.

D. Assume per farm profits of $20,725 to $22,800 - a decline of 19% to 26% from current farm net revenues with the loss of phosmet for the production of blueberries in the North Central Region.

Regional Level Impacts

1. Net Revenue (Profit) Impacts

A. Assume that current revenues are equal to $2,605 per acre, and costs are $1,485 per acre, resulting in net revenues of $1,120 per acre. Assume 17,300 blueberry bearing acres grown in the North Central Region. Assume net revenues of $19.4 million in the North Central Region from growing blueberries.

B. Assume revenues decline to $2,350 to $2,433 per acre, and costs increase to $1,521 per acre. Net revenues equal $829 to $912 per acre.

C. Assume at least 72% of the North Central Region blueberry acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (12,456acres). The remaining 4,844 acres will not be impacted.

D. Assume net revenues of $15.7 to $16.8 million in the North Central Region - a decline of 13% to 19% - in the North Central Region producing blueberries without azinphos-methyl and phosmet.

East Region

SCENARIO 1:
Azinphos-methyl REI less than or equal to 7 days. Phosmet REI greater than 3 days. Blueberry growers would no longer use phosmet.

Grower Level Impacts
1. Assume if a grower is using azinphos-methyl and phosmet, they would treat every acre of blueberries on their farm with azinphos-methyl and phosmet.

2. Revenue Impact - f(yield, price (quality))
Revenues are impacted through changes in yield and/or quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold.

A. Assume in the East production of 3,685 pounds of blueberries per acre, with a value of $3,595 per acre. This assumes 2,765 pounds per acre (75%) is destined for the fresh market (at a price of $1.10 per pound), and 920 pounds per acre (25%) is destined for the processed market (at a price of $0.60 per pound).

B. Assume no loss in yield without phosmet available.

C. Assume a quality loss in the blueberries produced as a result of damage caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the blueberries (i.e., fresh, processed, or no sale) and, therefore, the price received for production.

D. Assume the price received by growers for fresh market blueberries is equal to $1.10 per pound, and for processed market blueberries, $0.60 per pound. Also assume the potential change in price received for production is equal to $0 per pound (no change in end use market) to $0.60 per pound (change from processed market to no sale).

E. Assume, due to losses in the quality of the fruit, 5% to 10% of the current fresh blueberry production per acre goes to the processed market, and 10% to 15% of the current processed blueberry production per acre is not sold. Production destined for the fresh market declines to 2,489 to 2,627pounds per acre, and production destined for the processed market increases to 966 to 1,058 pounds per acre. The remaining 92 to 138 pounds per acre produced is not sold.

F. Assume the value of the fresh market production declines to $2,738 to $2,890 per acre, and the value of processed market production declines to $580 to $635 per acre. Revenues would equal $3,373 to $3,470 per acre - a decline of 3% to 6% from current per acre revenues of $3,695 per acre.

3. Cost Impact

A. Assume operating (variable) costs to be $2,090 per acre. The assessment is only focusing on operating costs. Fixed costs are $1,185 per acre, but are not included in this assessment.

B. Assume a change in variable costs due to additional insecticide control to replace the average of 2 applications of phosmet.

1. Assume 2 additional applications of methomyl, and 2 applications of malathion for the control of target pests. Additional cost of $40 per acre.

D. Assume variable costs increase $8 (the current cost of 2 applications of phosmet is $32 per acre) from $2,090 per acre to $2,098 per acre - an increase of <1%.

4. Net Revenue (Profit) Impacts

Per Acre

A. Assume that current revenues are equal to $3,595 per acre, and costs are $2,090 per acre, resulting in net revenues of $1,505 per acre.

B. Assume revenues decline to $3,373 to $3,470 per acre, and costs increase to $2,098 per acre. Net revenues equal $1,275 to $1,372 per acre - a decline of 9% to 15% from current per acre net revenues.

Per Farm

C. Assume that total current farm profits equal $16,555 (an average of 11 acres per farm at net revenues of $1,505 per acre) in the East Region from blueberry production.

D. Assume per farm profits of $14,025 to $15,092 - a decline of 9% to 15% from current farm net revenues with the loss of phosmet for the production of blueberries in the East Region.

Regional Level Impacts

1. Net Revenue (Profit) Impacts

A. Assume that current revenues are equal to $3,595 per acre, and costs are $2,090 per acre, resulting in net revenues of $1,505 per acre. Assume17,700 blueberry bearing acres grown in the East Region. Assume net revenues of $26.6 million in the East Region from growing blueberries.

B. Assume revenues decline to $3,373 to $3,470 per acre, and costs increase to $2,098 per acre. Net revenues equal $1,275 to $1,372 per acre.

C. Assume 22% of the East Region blueberry acreage treated with phosmet. Assume this is the acreage potentially impacted (3,894 acres). The remaining 13,806 acres will not be impacted.

D. Assume net revenues of $25.8 to $26.1 million in the East Region - a decline of 2% to 3% - in the East Region producing blueberries without phosmet.

<u>SCENARIO 2:</u>
Azinphos-methyl REI greater than 7 days. Phosmet REI less than or equal to 3 days. Blueberry growers would no longer use azinphos-methyl.

Grower Level Impacts
1. Assume if a grower is using azinphos-methyl and phosmet, they would treat every acre of blueberries on their farm with azinphos-methyl and phosmet.

2. Revenue Impact - f(yield, price (quality))
Revenues are impacted through changes in yield and/or quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold.

A. Assume in the East production of 3,685 pounds of blueberries per acre, with a value of $3,595 per acre. This assumes 2,765 pounds per acre (75%) is destined for the fresh market (at a price of $1.10 per pound), and 920 pounds per acre (25%) is destined for the processed market (at a price of $0.60 per pound).

B. Assume no loss in yield without phosmet available.

C. Assume a quality loss in the blueberries produced as a result of damage caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the blueberries (i.e., fresh, processed, or no sale) and, therefore, the price received for production.

D. Assume the price received by growers for fresh market blueberries is equal to $1.10 per pound, and for processed market blueberries, $0.60 per pound. Also assume the potential change in price received for production is equal to $0 per pound (no change in end use market) to $0.60 per pound (change from processed market to no sale).

E. Assume, due to losses in the quality of the fruit, 1% to 2% of the current fresh blueberry production per acre goes to the processed market, and 1% to 2% of the current processed blueberry production per acre is not sold. Production destined for the fresh market declines to 2,710 to 2,737 pounds per acre, and production destined for the processed market increases to 939 to 957 pounds per acre. The remaining 9 to 18 pounds per acre produced is not sold.

F. Assume the value of the fresh market production declines to $2,981 to $3,011 per acre, and the value of processed market production declines to $563 to $574 per acre. Revenues would equal $3,555 to $3,574 per acre - a decline of 1% from current per acre revenues of $3,695 per acre.

3. Cost Impact

A. Assume operating (variable) costs to be $2,090 per acre. The assessment is only focusing on operating costs. Fixed costs are $1,185 per acre, but are not included in this assessment.

B. Assume a change in variable costs due to additional insecticide control to replace the average of 2 applications of azinphos-methyl.

1. Assume 1 additional applications of tebufenozide, 1 application of carbaryl, and 1 application of esfenvalerate for the control of target pests. Additional cost of $34 per acre.

C. Assume variable costs increase $8 (the current cost of 2 applications of azinphos-methyl is $26 per acre) from $2,090 per acre to $2,098 per acre - an increase of <1%.

4. Net Revenue (Profit) Impacts

Per Acre
A. Assume that current revenues are equal to $3,595 per acre, and costs are $2,090 per acre, resulting in net revenues of $1,505 per acre.

B. Assume revenues decline to $3,555 to $3,574 per acre, and costs increase to $2,098 per acre. Net revenues equal $1,457 to $1,476 per acre - a decline of 2% to 3% from current per acre net revenues.

Per Farm
C. Assume that total current farm profits equal $16,555 (an average of 11 acres per farm at net revenues of $1,505 per acre) in the East Region from blueberry production.

D. Assume per farm profits of $16,027 to $16,236 - a decline of 2% to 3% from current farm net revenues with the loss of azinphos-methyl for the production of blueberries in the East Region.

Regional Level Impacts

1. Net Revenue (Profit) Impacts

A. Assume that current revenues are equal to $3,595 per acre, and costs are $2,090 per acre, resulting in net revenues of $1,505 per acre. Assume17,700 blueberry bearing acres grown in the East Region. Assume net revenues of $26.6 million in the East Region from growing blueberries.

B. Assume revenues decline to $3,555 to $3,574 per acre, and costs increase to $2,098 per acre. Net revenues equal $1,457 to $1,476 per acre.

C. Assume 23% of the East Region blueberry acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (4,071 acres). The remaining 13,629 acres will not be impacted.

D. Assume net revenues of $26.4 to $26.5 million in the East Region - a decline of 1% - in the East Region producing blueberries without azinphos-methyl.

SCENARIO 3:
Azinphos-methyl REI greater than 7 days. Phosmet REI greater than 3 days. Blueberry growers would no longer use azinphos-methyl or phosmet.

Grower Level Impacts

1. Assume if a grower is using azinphos-methyl and phosmet, they would treat every acre of blueberries on their farm with azinphos-methyl and phosmet.

2. Revenue Impact - f(yield, price (quality))

Revenues are impacted through changes in yield and/or quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold.

A. Assume in the East production of 3,685 pounds of blueberries per acre, with a value of $3,595 per acre. This assumes 2,765 pounds per acre (75%) is destined for the fresh market (at a price of $1.10 per pound), and 920 pounds per acre (25%) is destined for the processed market (at a price of $0.60 per pound).

B. Assume no loss in yield without phosmet available.

C. Assume a quality loss in the blueberries produced as a result of damage caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the blueberries (i.e., fresh, processed, or no sale) and, therefore, the price received for production.

D. Assume the price received by growers for fresh market blueberries is equal to $1.10 per pound, and for processed market blueberries, $0.60 per pound. Also assume the potential change in price received for production is equal to $0 per pound (no change in end use market) to $0.60 per pound (change from processed market to no sale).

E. Assume, due to losses in the quality of the fruit, 5% to 10% of the current fresh blueberry production per acre goes to the processed market, and 10% to 15% of the current processed blueberry production per acre is not sold. Production destined for the fresh market declines to 2,489 to 2,627pounds per acre, and production destined for the processed market increases to 966 to 1,058 pounds per acre. The remaining 92 to 138 pounds per acre produced is not sold.

F. Assume the value of the fresh market production declines to $2,738 to $2,890 per acre, and the value of processed market production declines to $580 to $635 per acre. Revenues would equal $3,373 to $3,470per acre - a decline of 3% to 6% from current per acre revenues of $3,695 per acre.

3. Cost Impact

A. Assume operating (variable) costs to be $2,090 per acre. The assessment is only focusing on operating costs. Fixed costs are $1,185 per acre, but are not included in this assessment.

B. Assume a change in variable costs due to additional insecticide control to replace the average of 2 applications of phosmet and 2 applications of azinphos-methyl.

1. Assume 2 additional applications of methomyl, 1 application of esfenvalerate, 1 application of carbaryl, 1 application of tebufenozide, and 2 applications of malathion for the control of target pests. Additional cost of $74 per acre.

C. Assume variable costs increase $16 (the current cost of 2 applications of phosmet and 2 appications of azinphos-methyl is $58 per acre) from $2,090 per acre to $2,106 per acre - an increase of 1%.

4. Net Revenue (Profit) Impacts

Per Acre

A. Assume that current revenues are equal to $3,595 per acre, and costs are $2,090 per acre, resulting in net revenues of $1,505 per acre.

B. Assume revenues decline to $3,373 to $3,470 per acre, and costs increase to $2,106 per acre. Net revenues equal $1,267 to $1,364 per acre - a decline of 9% to 16% from current per acre net revenues.

Per Farm

C. Assume that total current farm profits equal $16,555 (an average of 11 acres per farm at net revenues of $1,505 per acre) in the East Region from blueberry production.

D. Assume per farm profits of $13,937 to $15,004 - a decline of 9% to 16% from current farm net revenues with the loss of phosmet and azinphos-methyl for the production of blueberries in the East Region.

Regional Level Impacts

1. Net Revenue (Profit) Impacts

A. Assume that current revenues are equal to $3,595 per acre, and costs are $2,090 per acre, resulting in net revenues of $1,505 per acre. Assume17,700 blueberry bearing acres grown in the East Region. Assume net revenues of $26.6 million in the East Region from growing blueberries.

B. Assume revenues decline to $3,373 to $3,470 per acre, and costs increase to $2,106 per acre. Net revenues equal $1,267 to $1,364 per acre.

C. Assume at least 23% of the East Region blueberry acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (4,071 acres). The remaining 13,629 acres will not be impacted.

D. Assume net revenues of $25.7 to $26.1 million in the East Region - a decline of 2% to 3% - in the East Region producing blueberries without phosmet and azinphos-methyl.

<u>North Central and East Region</u>

Highbush Blueberry Grower and Regional Level Impact Summary

The following three tables summarize, by scenario, the grower and regional impacts of extending the REIs of azinphos-methyl and phosmet on blueberries in the North Central Region and East Region. Tables 16 and 17 summarize the estimated grower level impacts for the North Central Region and East Region, respectively, and Table 18 summarizes the regional level impacts in the North Central Region and East Region.

Table 16. Summary of North Central Region Highbush Blueberry Grower Level Impacts

Scenario	Yield	Quality Impact (Price)	Revenues	Operating Costs	Net Revenues
Current Situation	Current total: Total: 3,610 lbs/A Fr: 1,100 lbs/A Proc: 2,510 lbs/A	Prices: Total: $0.72/lb Fr: $1.00/lb Proc: $0.60/lb	Current: $2,605/A	Current: $1,485/A	Current: $1,120/A

Scenario	Yield	Quality Impact (Price)	Revenues	Operating Costs	Net Revenues
1 REIs: Azinphos-methyl: =/<7 days Phosmet: >3 days	Yield loss: None	Quality Loss: Fr to Proc: 3-5% Proc to no sale: 5-15% Fr New Total: 1,045 - 1,067 lbs/A Proc New Total: 2,189 - 2,417 lbs/A No Sale New Total: 126 - 376 lbs/A	New: $2,358/A to $2,517/A	New: $1,513/A	New: $845/A to $1,004/A **Net Loss:** $116/A to $275/A
2 REIs: Azinphos-methyl: >7 days Phosmet: =/<3 days	Yield loss: None	Quality Loss: Fr to Proc: 1-2% Proc to no sale: 1-2% Fr New Total: 1,078 - 1,089 lbs/A Proc New Total: 2,482 - 2,496 lbs/A No Sale New Total: 25 - 50 lbs/A	New: $2,567/A to $2,587/A	New: $1,493/A	New: $1,074/A to $1,094/A **Net Loss:** $26/A to $46/A
3 REIs: Azinphos-methyl: >7 days Phosmet: >3 days	Yield loss: None	Quality Loss: Fr to Proc: 5-7% Proc to no sale:10-15% Fr New Total: 1,023 -1,045 lbs/A Proc New Total: 2,211 - 2,314 lbs/A No Sale New Total: 251 -376 lbs/A	New: $2,350/A to $2,433/A	New: $1,521/A	New: $829/A to $912/A **Net Loss:** $208/A to $291/A

Table 17. Summary of East Region Highbush Blueberry Grower Level Impacts

Scenario	Yield	Quality Impact (Price)	Revenues	Costs	Net Revenues
Current Situation	Current total: Total: 3,685 lbs/A Fr: 2,765 lbs/A Proc: 920 lbs/A	Prices: Total: $0.98/lb Fr: $1.10/lb Proc: $0.60/lb	Current: $3,595/A	Current: $2,090/A	Current: $1,505/A

Scenario	Yield	Quality Impact (Price)	Revenues	Costs	Net Revenues
1 REIs: Azinphos- methyl: =/<7 days Phosmet: >3 days	Yield loss: None	Quality Loss: Fr to Proc: 5-10% Proc to no sale: 5-15% Fr New Total: 2,489 - 2,627 lbs/A Proc New Total: 966 - 1,058 lbs/A No Sale New Total: 92 - 138 lbs/A	New: $3,373/A to $3,470/A	New: $2,098/A	New: $1,275/A to $1,372/A **Net Loss:** $138/A to $230/A
2 REIs: Azinphos- methyl: >7 days Phosmet: =/<3 days	Yield loss: None	Quality Loss: Fr to Proc: 1-2% Proc to no sale: 1-2% Fr New Total: 2,710 - 2,737 lbs/A Proc New Total: 939 - 957 lbs/A No Sale New Total: 9 - 18 lbs/A	New: $3,555/A to $3,574/A	New: $2,098/A	New: $1,457/A to $1,476/A **Net Loss:** $29/A to $48/A
3 REIs: Azinphos- methyl: >7 days Phosmet: >3 days	Yield loss: None	Quality Loss: Fr to Proc: 5-10% Proc to no sale: 5-15% Fr New Total: 2,049 - 2,627 lbs/A Proc New Total: 966 - 1,058 lbs/A No Sale New Total: 92 - 138 lbs/A	New: $3,373/A to $3,470/A	New: $2,106/A	New: $1,267/A to $1,364/A **Net Loss:** $141/A to $238/A

Table 18. Summary of North Central Region and East Region Highbush Blueberry Regional Level Impacts

<table>
<tr><th>Scenario</th><th>Region</th><th>Net Revenues</th></tr>
<tr><td rowspan="2">1
REIs:
Azinphos-methyl: =/<7 days

Phosmet: >3 days</td><td>North Central</td><td>Current total: $19.4 million
New Total: $16.8 to $18.3 million
Net Loss: $1.1 to $2.6 million</td></tr>
<tr><td>East</td><td>Current total: $26.6 million
New Total: $25.8 to $26.1 million
Net Loss: $0.5 to $0.8 million</td></tr>
<tr><td rowspan="2">2
REIs:
Azinphos-methyl: >7 days

Phosmet:: =/<3 days</td><td>North Central</td><td>Current total: $19.4 million
New Total: $18.8 to $19 million
Net Loss: $0.4 to $0.6 million</td></tr>
<tr><td>East</td><td>Current total: $26.6 million
New Total: $26.4 to $26.5 million
Net Loss: $0.1 to $0.2 million</td></tr>
<tr><td rowspan="2">3
REIs:
Azinphos-methyl: >7 days

Phosmet: >3 days</td><td>North Central</td><td>Current total: $19.4 million
New Total: $15.7 to $16.8 million
Net Loss: $2.6 to $3.7 million</td></tr>
<tr><td>East</td><td>Current total: $26.6 million
New Total: $25.7 to $26.1 million
Net Loss: $0.5 to $0.9 million</td></tr>
</table>

Sources

Wild Blueberry Culture in Maine, Fact Sheet no. 220, revised 1998. University of Maine Cooperative Extension.

Monitoring for the Blueberry Maggot, Fact sheet no. 201, 1987. University of Maine Cooperative Extension.

USDA Crop Profile for Blueberries (Wild) in Maine, Aug 1999.

USDA Crop Profile for Blueberries in North Carolina, Nov 1999.

USDA Crop Profile for Blueberries in Michigan, May 1999.

USDA Crop Profile for Blueberries in Oregon, Feb 2000.

USDA Crop Profile for Blueberries in Rhode Island, Nov 1998.

USDA Crop Profile for Blueberries in New Hampshire, Aug 1999.

USDA Crop Profile for Blueberries in New York, Mar 2000.

USDA Crop Profile for Blueberries in Georgia, Jul 1999.

National Center for Food and Agricultural Policy (NCFAP) National Pesticide Use Database for 1992 and 1997.

Yarborough, D., University of Maine. Personal communication with N. Anderson on 3/15/2001. (207) 581-2923.

USDA/NASS, Non-Citrus Fruits and Nuts 2000 Preliminary Summary, Jan. 2001.

USDA/NASS Agricultural Chemical Usage: Fruit and Nut Summary , 1997 and 1999.

Blueberry Pest Management Strategic Plan.